COMPOSITIONS OF NORMAL AND ANOMALOUS EUCRITE-TYPE MAFIC ACHONDRITES.

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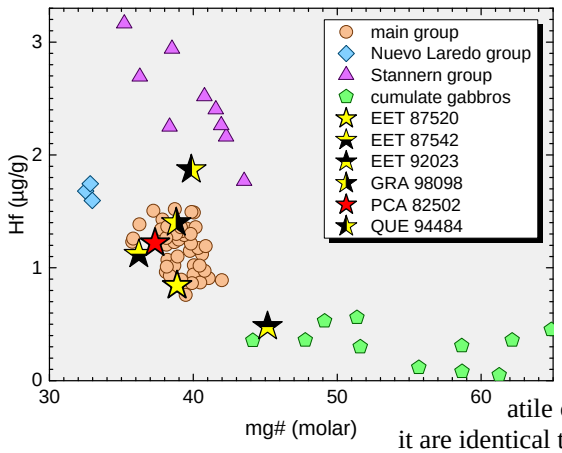
Introduction: The most common asteroidal igneous meteorites are eucrite-type mafic achondrites – basalts and gabbros composed of ferroan pigeonite, ferroan augite, calcic plagioclase, silica, ilmenite, troilite, Ca-phosphate, chromite and Fe-metal [1]. These rocks are thought to have formed on a single asteroid along with howardites and diogenites. However, high precision O-isotopic analyses have shown that some mafic achondrites have small, well-resolved, non-mass-dependent differences that have been interpreted as indicating derivation from different asteroids [e.g., 2]. Some of these O-anomalous mafic achondrites also have anomalous petrologic characteristics, strengthening the case that they hail from distinct parent asteroids [3]. We present the results of bulk compositional studies of a suite of normal and anomalous eucrite-type basalts and cumulate gabbros.

Methods and Samples: Compositions were determined by: X-ray fluorescence spectrometry (XRF) done at Franklin & Marshall College; instrumental neutron activation analysis (INAA); and inductively coupled plasma mass spectrometry (ICP-MS) done at NASA JSC (see [4] for methodology). The INAA analyses were done on ~50 mg splits taken from chips ~200-800 mg in mass. Samples for XRF/ICP-MS were done on splits of homogenized powders prepared from ~5 gram chips. This abstract focuses on EET 87520, EET 87542, EET 92023, GRA 98098, Orlando (a 2004 fall), PCA 82502 and QUE 94484. We did not have sufficient mass of QUE 94484 to allow for XRF. Many Antarctic eucrites have suffered terrestrial mobilization of phosphate-hosted incompatible lithophile elements; we rely on the less mobile incompatible lithophile elements Zr, Nb, Ba, Hf and Ta to assess their origin (cf., [5]).

Results and Discussion: EET 87520, EET 87542 and GRA 98098 are main-group basaltic eucrites as evidenced by their normal O-isotopic compositions [3], and bulk rock molar 100*[MgO/(MgO+FeO)] (mg#) and incompatible lithophile element contents (figure; literature data from compilation [1]). EET 87520, classified as an Mg-rich eucrite, has an mg# typical of main-group eucrites; its pyroxene compositions also match main-group eucrites [3]. Incompatible lithophile element contents in EET 87520 are similar to those of basaltic clasts from Sioux County [6]. EET 87542 suffered late, subsolidus reduction of FeO from pyroxene [3]. Nevertheless, the mg# and incompatible lithophile element contents of it are consistent with main-group eucrites. Our INAA data on GRA 98098 have incompatible lithophile element contents within the ranges of Nuevo-Laredo-group and Stannern-group eucrites. However, the larger, more representative, XRF/ICP-MS sample matches main-group eucrites (figure). Orlando, a moderately brecciated, medium-grained basalt, has incompatible lithophile element contents that are typical for main-group eucrites. Its pyroxene compositions also match the main group [3]; we did not determine a bulk rock mg# for Orlando.



Unbrecciated basalt QUE 94484 suffered late-stage reduction of FeO from the magma during crystallization, but has a normal eucritic O-isotopic composition [3]. Its mg# and incompatible lithophile element contents more closely match Stannern-group eucrites than main-group or Nuevo-Laredo-group eucrites (figure). The compositional data suggest that QUE 94484 might be a member of the Stannern group; further analyses are required to firmly establish this conclusion.

Anomalous basalt PCA 82502 is fine-grained and vesicular, and paired with PCA 91007 [3]. PCA 82502 has an mg# and incompatible lithophile element contents within the field of main-group eucrites (figure), and comparable to those in PCA 91007 [7]. The vesicularity indicates a high magma volatile content, but the volatile lithophile element (Rb, Cs) contents of it are identical to those of main-group eucrites.

Anomalous cumulate gabbro EET 92023 contains Ni-rich metal, pyroxenes with high Fe/Mn ratios, and has an O-isotopic composition distinct from those of normal eucrites [3]. Its incompatible lithophile element contents are consistent with a cumulate origin, and are similar to those of Moore County (cf., [5]). Its bulk mg# is lower than that of Moore County because of the metal; the pyroxene mg#s of EET 92023 and Moore County are identical [3].

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